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LXXII.—*A new Davaineid Cestode*—Raillietina (Paroniella) macropa, sp. n., from a Wallaby. By R. J. ORTLEPP, M.A., Parasitologist to the Zoological Society of London*.

SOURCE OF MATERIAL.

From the intestines of two Brunii's Wallabys—*Macropus brunii*,—which died in the Gardens of the London Zoological Society in November 1921, a number of cestodes were collected. One wallaby had only a single cestode, whereas the other had about half-a-dozen. The latter had been in the Gardens a few months longer than the former.

METHODS OF STUDY.

(a) *Preservation*.—Some of the cestodes which were required for sectionising were fixed in hot Schaudinn's

* From the Helminthological Department, London School of Tropical Medicine.

solution for about a quarter of an hour, after which they were washed for a few hours in running water, and were then placed in 70 % alcohol to which a few drops of iodine solution were added. The addition of iodine was continued until the colour was permanent, after which it was poured off and replaced by 70 % alcohol, in which the animals were permanently preserved. The rest of the worms were placed in tap-water, and allowed to remain in it until they were completely relaxed and dead. They were then dropped into a preserving fluid, consisting of equal parts of pure glycerine, 70 % alcohol, and distilled water, and as this fluid became turbid it was replaced by fresh preservative. This preservative tends to keep the worms soft, and such specimens, after the excess of glycerine has been washed out by distilled water, are found to stain very well with Ehrlich's acid hæmatoxylin.

(b) *Study*.—Serial transverse and horizontal sections, 7 μ thick, were cut of mature and ripe proglottids; these were stained with Ehrlich's acid hæmatoxylin with eosin as a counter stain. For the preparation of whole mounts, weak Ehrlich's acid hæmatoxylin was used, and the worms were allowed to stain overnight; they were then differentiated in acid alcohol and eventually blued in tap-water; after slightly pressing them between two microscopic slides and dehydrating them in this condition, the worms were finally mounted in Canada balsam. Acetic alum hæmatin and acetic acid carmine were also tried, but these stains did not give satisfactory results.

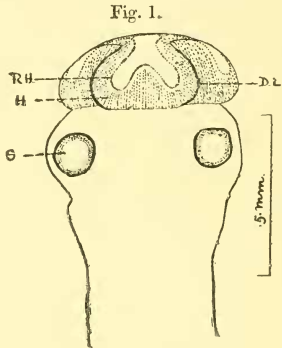
EXTERNAL CHARACTERS.

(a) *External Appearance*.—The specimens vary in length from 24 cms. to 35 cms. Anteriorly the body is very much attenuated, but posteriorly it gradually increases until about halfway down its length; here the maximum breadth—about 4 mm.—is attained; more posteriorly the strobila again becomes narrowed, so that at its hind end it is only about 1 mm. broad.

The anterior segments are very narrow, but they become slightly longer posteriorly, and in the middle of the body they are about one-tenth as long as they are broad. Towards the end of the body the segments decrease in breadth and increase in length, so that the terminal segments are about twice as long as they are broad, and somewhat barrel-shaped. The posterior lateral margin of each segment projects slightly over the segment following: this is more marked

in the anterior half, where these projections give the outline of the strobila a finely serrated appearance.

(b) *Head*.—The scolex (fig. 1) is well developed, measuring across the suckers from $580\ \mu$ to $650\ \mu$ in breadth, with a length varying from about $500\ \mu$ to $600\ \mu$. Its anterior portion forms a large and somewhat antero-posteriorly flattened protuberance; viewed from the anterior aspect this protuberance is roughly quadriradiate, each ray forming



Head.

D.L. = dorsal lobe of head protuberance; *H.* = hooks covering protuberance; *R.H.* = rostellar hooks; *S.* = sucker.

Fig. 2.



a = rostellar hooks; *b* = hooks from suckers; *c* = hooks covering the protuberance.

the axis of a bulb-like swelling, separated from its immediate neighbour on either side by a valley. These four lobes are situated one dorsal, one ventral, and two lateral.

Except for their median areas the whole surface of these lobes is covered by numerous minute hooks, $5\ \mu$ to $6\ \mu$ long (figs. 1 and 2 *c*)—these are arranged in longitudinal rows.

The anterior face of the protuberance is occupied by the rostellum, which is sunk into it. The rostellar hooks are of

the usual *Davainea* type (fig. 2 a), and are set in two rows, the hooks of the posterior row irregularly alternating with those of the anterior row. They are all of the same size, measuring about 9μ long. The crown formed by these hooks is very striking, in that they bound an area resembling that of an equal-armed cross, the extremity of each of whose arms is bifid. Each ray with its subdivisions occupies the middle area of one of the lobes of the protuberance, the four rays meeting on the anterior face of the protuberance. These hooks easily become detached, and consequently it was not possible to determine their number, but a rough estimation placed them at about 650 for each row.

The rest of the head, which is slightly broader than its anterior protuberance, is separated off from it by a well-defined constriction.

There are four rounded suckers placed on slight elevations, each elevation being situated opposite one of the depressions in the anterior head protuberance; thus they occupy a somewhat lateral position, two being subdorsal and two subventral. The outer margin of each sucker is beset with numerous small hooklets, about 5μ long (fig. 2 b), arranged in diagonal rows of about a dozen hooks in each row. The suckers are somewhat cup-shaped, measuring about 130μ across their mouths and having a depth of about 70μ .

(c) *Neck*.—A distinct neck is present, which is of a uniform breadth throughout its length. Its breadth, in different worms, varies from 380μ to 417μ , and its length varies from 800μ to 1200μ . This variation appears to be due to the different sizes of the worms, and also to different states of contraction.

(d) *Segments*.—The first-formed segments are very short, and are as broad as the neck, the older segments increase both in length and in breadth, until about the middle of the strobila is reached, where they are about 230μ long and 4 mm. broad. As the segments become ripe they increase in length and decrease in breadth, so that the ripe segments at the end of the body are about twice as long as broad, measuring about 2.5 mm. in length by 1.3 mm. in breadth.

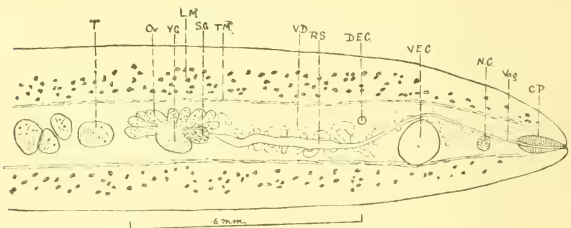
INTERNAL ANATOMY.

(a) *Muscular System* (fig. 3).—The longitudinal muscle-system is well developed, and consists of a single layer of irregularly scattered muscle-fibres occupying the dorsal and ventral thirds of the proglottid. The transverse muscle-fibres form a thin layer of delicate fibres immediately internal to the longitudinal muscle-fibres; they bound the

dorsal and ventral surfaces of the middle third of the segment, in which all the genital organs are confined. Dorso-ventral muscles were not observed.

(b) *Excretory System*.—The excretory system consists of two longitudinal vessels, dorsal and ventral, on either side towards the lateral margins of the segments. In the head region the corresponding vessels from each side unite and form a loop between the suckers. The ventral excretory vessels are large and thin-walled; they are more or less circular in transverse section, with a diameter of about $110\ \mu$ in mature segments. In the hinder end of each segment a transverse duct, $25\ \mu$ in diameter, connects the ventral vessels. The dorsal excretory vessels are much smaller, but

Fig. 3.



Transverse section of portion of mature segment, reconstructed from serial sections.

C.P. = cirrus-pouch; *D.E.C.* = dorsal excretory canal; *L.M.* = longitudinal muscle-layer; *N.C.* = nerve-cord; *Ov.* = ovary; *R.S.* = receptaculum seminis; *S.G.* = shell-gland; *T.* = testis; *T.M.* = transverse muscle-layer; *Vag.* = Vagina; *V.D.* = vas deferens; *V.E.C.* = ventral excretory canal; *Y.G.* = yolk-gland.

have a thicker and slightly muscular wall; they are situated at about the level of the dorsal margin of the ventral vessel, but more towards the interior of the segment. In transverse section they are circular with a diameter of $15\ \mu$. Like the ventral vessels they also are connected to each other by transverse vessels, situated one at the hinder end of each segment, and running parallel to, but dorsal of, those connecting the ventral vessels. Towards the posterior end of the strobila the lumen of the dorsal vessels may increase in diameter, so that in ripe segments they may attain about half the diameter of the ventral vessels.

(c) *Nervous System*.—The nervous system consists of two well-developed lateral nerve-trunks. In general, the poral

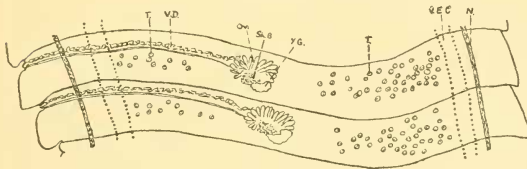
trunk is situated about midway between the ventral excretory vessel and the inner margin of the cirrus-pouch; it may, however, approach and lie close to the excretory vessel. On the aporal side the nerve-trunk lies in close proximity to the ventral excretory vessel. The course of the nerves in the head region was not followed.

(d) *Genital Organs* (figs. 3 and 4).—Each mature segment possesses one complete set of male and female genitalia, with their genital pores close together and unilateral in position.

These pores are in the anterior third of the segment, and are situated on a slight eminence. Each eminence is overhung by the projecting posterior angle of the segment preceding.

The genital rudiments of the ovaries are the first to appear

Fig. 4.



Mature segments, slightly flattened.
(Magnification about 40.)

N.=nerve-cord; Ov.=ovary; Sh.G.=shell-gland; T.=testes; V.D.=vas deferens; V.E.C.=ventral excretory gland; Y.G.=yolk-gland.

about 8 mm. from the anterior end; some mms. further down the vagina begins to develop, to be soon followed by the vas deferens. The rudiments of the testes appear very much later, their first indications being at about 40 mm. from the anterior end. Mature segments are found about 5 mm. further down.

All the genitalia are confined to the central third of the parenchyma, being bound dorsally and ventrally by the thin sheet of transverse muscles and laterally by the ventral excretory canals.

The male organs consist of about 50 rounded testes, about $65\ \mu$ in diameter, arranged in two groups separated by the ovary. The larger group, which consists of about three-fourths of the number of testes, is situated aporally. The testes do not pass laterally over the ventral excretory canal.

A fine duct, vas efferens, arises from each testis; these eventually unite together to form the large and much convoluted vas deferens. The vas deferens commences just dorsal of the ovary, and its convolutions fill up the space between the ovary and the ventral excretory vessel; having reached this vessel the vas deferens bends upwards, passing over and between it and the dorsal excretory vessel. It then again passes ventralwards and with a few convolutions passes dorsal of the nerve-trunk to join up with the cirrus. Throughout its whole course it is thin-walled with its lumen filled with spermatozoa. The cirrus is small, unarmed, and only feebly muscular; it is lodged inside the cirrus-pouch and its proximal portion may form one or two slight bends.

The cirrus-pouch is pyriform in shape, about 100μ long and 40μ broad at its proximal end. It has a weakly muscular wall, possessing only a thin layer of muscular fibres. Its opening is on the edge of the proglottid, on a slight bulging overhung by the free posterior angle of the segment preceding.

The ovary is situated in the middle of the segment. It consists of about 15 club-shaped lobules, radiating dorsally, anteriorly, and ventrally from their common centre. Its lateral diameter is about 200μ . A slight concavity in its posterior face is occupied by the shell and yolk glands. The yolk-gland, which is about one-fifth as large as the ovary, occupies a position aporally, while the shell-gland, which is about one-twelfth as large as the ovary, occupies a more or less similar position on the poral side of the ovary.

The vaginal aperture is situated immediately posterior to that of the cirrus-pouch; it passes straight inwards along the posterior edge of the cirrus-pouch to the dorsal surface of the ventral excretory canal. This distal portion of the vagina is thick-walled and muscular, having a very small lumen. On passing over the ventral excretory canal it bends obliquely inwards, passing between the dorsal and ventral excretory canals, and at the same time its wall becomes much thinner and its lumen much enlarged. The portion of the female duct from here to the ovary I take to be the receptaculum seminis, especially as it is in all mature segments filled with spermatozoa. The proximal portion of the receptaculum seminis bends obliquely upwards and passes into the ovary.

A functional uterus is not developed; the eggs when found become scattered about singly throughout the central body parenchyma, being limited laterally by the ventral excretory vessels and dorsally and ventrally by the transverse muscle-sheath.

DISCUSSION.

Fuhrmann, in 1920, separated from the old genus *Davainea*, Bl., four new genera, limiting the genus *Davainea* to those small forms possessing a restricted number of segments (4-15), small suckers, feeble musculature, regularly alternating genital pores, and uterine capsules possessing only a single onchosphere. Three of his new genera comprise only four species, whereas his fourth—*Raillietina*—includes almost 90 species. This genus he characterises as follows:—"Cestodes à scolex arrondi surmonté d'un rostre de structure simple, armé d'une couronne double (rarement simple ?) de crochets nombreux, petits et d'une forme spéciale. Ventouses plus ou moins arrondies, entourées de plusieurs rangées de petits crochets ou spicules, cadues ou persistant pendant toute la vie. Pores génitaux unilatéraux ou irrégulièrement alternes. Utérus manquant dans les proglottis mûrs ; à sa place des capsules parenchymateuses renfermant une ou plusieurs onchosphères."

He further subdivides the genus *Raillietina* into four subgenera, basing his differentiating characters on the position, unilateral or irregularly alternating, of the genital pores, and on the number of onchospheres, single or more, contained in each uterine capsule.

Referring the species described above to this new grouping of the Davaineas, it is seen that it belongs to the genus *Raillietina* and to its subgenus *Paroniella*. This subgenus is characterised by having unilateral genital pores and the uterine capsules contain only a single onchosphere.

From the available literature dealing with cestodes from Marsupials it appears that sixteen cestode genera have been recorded from this group of Mammals. These cestodes, together with *Raillietina* (*Paroniella*) *macropa*, sp. n., are practically all Cyclophyllids, only one genus—*Bothriocephalus*—belonging to another order, namely Pseudophyllidea. Of the Cyclophyllidean families all are represented except two—namely, the families Tetrabothriidæ and Mesocestoididæ.

I wish to express my indebtedness to the Zoological Society of London for the opportunity offered of collecting these parasites at their prosectorium. My thanks are also due to Mr. R. I. Pocock, F.R.S., for valuable assistance in the classification and nomenclature of the marsupial hosts.

The appended host list is an attempt towards the compilation of all the cestodes which have been described or

reported from Marsupials. These have been arranged according to the families of the latter :—

Suborder DIPROTODONTIA.

Family **Macropodidæ**.

- Macropus agilis*, Gould.
Hepatotænia fellicola, Nybelin, 1917.
- Macropus brunii*, Schreber.
Paroniella macropa, sp. n.
- Macropus derbianus*, Gray.
Hepatotænia festiva (Rud., 1819), Nybelin, 1917.
[Syn. Moniezia festiva (Rud., 1819), R. Bl., 1891.]
- Macropus dorsalis*, Gray.
Echinococcus granulosus (Batsch, 1786), Rud., 1805.
- Macropus eugenii*, Desm.
[Syn. M. thetidis, Less.]
Echinococcus granulosus (Batsch, 1786), Rud., 1805.
- Macropus giganteus*, Zimm.
Hepatotænia festiva (Rud., 1819), Nybelin, 1917.
Echinococcus granulosus (Batsch, 1786), Rud., 1805.
- Macropus robustus*, Gould.
Echinococcus granulosus (Batsch, 1787), Rud., 1805.
- Macropus ulabatus*, Less & Garn.
Bancroftiella tenuis, Johns., 1911.
Echinococcus granulosus (Batsch, 1786), Rud., 1805.
- Macropus* sp.
Progamotænia zschokkei (Janick, 1905), Nybelin, 1917.
[Syn. Cittotænia zschokkei, Janicki, 1905.]
Tænia? krefftii (Krefft, 1871), Johnst., 1909.
[Syn. Bothriocephalus marginatus, Krefft.]
Tænia mastersii, Krefft, 1871.
Triplotænia mirabilis, Boas, 1902.
- Lagorchestes conspicillatus*, Gould.
Progamotænia lagorchestis (Lewis, 1914), Nybelin, 1917.
[Syn. Cittotænia lagorchestis, Lewis, 1914.]
Cittotænia villosa, Lewis, 1914.
- Petrogale penicillata*, Gray.
Triplotænia mirabilis, Boas, 1902.
- Onychogale unguifera*, Gould.
Hepatotænia festiva (Rud., 1819), Nybelin, 1917.
Progamotænia bancrofti (Johnston, 1913), Nybelin, 1917.
[Syn. Cittotænia bancrofti, Johnst., 1913.]

Family **Phalangeridæ**.

- Phalanger ursinus*, Temm.
Bertiella edulis, Zsch., 1898.
Bertiella sarasinorum, Zsch., 1898.
- Pseudochirus lemuroides*, Collett.
Bertiella undulata, Nybelin, 1917.
Bertiella pellucida, Nybelin, 1917.
Parabertiella campanulata, Nybelin, 1917.

- Pseudochirus herbertensis*, Collett.
Bertiella pseudochiri, Nybelin, 1917.
Bertiella aberrata, Nybelin, 1917.

- Trichosurus vulpecula*, Kerr.
Tænia phalangistæ, Krefft, 1871.

- Trichosurus* sp.
Bertiella rigida, Janicki, 1905.

Family **Phascolarctidæ.**

- Phascolarctus cinereus*, Goldf.
Bertiella obesa, Zsch., 1898.
Tænia geophiloides, Cobb., 1879.

Family **Phascolomyidæ.**

- Phascolomys ursinus*, Shaw.
Hepatotænia diaphana (Zsch., 1907), Nybelin, 1917.
 [Syn. *Moniezia diaphana*, Zsch., 1907.]
- Phascolomys* sp.
Hepatotænia diaphana (Zsch., 1907), Nybelin, 1917.
 [Syns. *Tænia bipapillosa*, Leidy, 1875.
Moniezia festiva (Rud., 1819), R. Bl., 1891.]

Suborder POLYPROTODONTIA.

Family **Peramelidæ.**

- Perameles macrura*, Gould.
Hymenolepis peramelidarum, Nybelin, 1917.
Linstowia semoni (Zsch., 1899), var. *acanthocirrosa*, Nybelin,
 [1917.]
- Perameles nasuta*, Géoffr.
Linstowia semoni (Zsch., 1896), Zsch., 1899.
- Perameles obesula*, Shaw.
Linstowia echidnæ (Thomp., 1893), Zsch., 1899.
Linstowia semoni (Zsch., 1896), Zsch., 1899.

Family **Dasyuridæ.**

- Sarcophilus satanicus*, Thomas.
 [Syn. *Dasyurus ursinus*, Harris.]
Anoplotænia dasyuri, Bedd., 1911.
Dasyurotænia robusta, Bedd., 1912.
- Thylacinus cynocephalus*, Harris.
Dithyridium (*Piestocystis*) *cynocephali*, Ransom, 1907.

Family **Didelphyidæ.**

- Didelphys azaræ* (host cited as *Macropus azaræ*).
Bothriocephalus didelphidis, Ariola, 1900.
- Marmosa elegans*, Waterh.
Ochoristica bivittata, Janicki, 1904.
Ochoristica didelphidis (Rud., 1819), Zsch., 1904.
Ochoristica marmosæ, Bedd., 1914.
Ochoristica murina, Zsch., 1904.

Peromys americana, Mull.

[Syn. *Didelphys tristriata*, Illig.]

Linstowia brasiliensis, Janicki, 1904.

Linstowia iheringi, Zsch., 1904.

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